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MONTHLY
MICROCLIMATIC SUMMARY

JULY 1967

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

USATECOM Project No. 74-0013-01

US ARMY
TROPIC TEST CENTER
Fort Clayton, Canal Zone

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MONTHLY
MICROCLIMATIC SUMMARY

JULY 1967

Prepared by

Michael A. Fradel, Project Officer
and
Dr. Wilfried H. Portig, Meteorologist
UEATECOM Project No. 9-4-0013-01

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MONTHLY MICROCLIMATIC SUMMARY

Introduction

Monthly microclimatic data summarized in this series of reports were collected by the US Army Tropic Test Center and the Weather Engineers of Panama Corporation under the project, Environmental Data Base for Regional Studies in the Humid Tropics. The project is sponsored by the Advanced Research Projects Agency of the Department of Defense and by the Army Research Office, Office of the Chief of Research and Development. It is an investigation of microclimatic, air chemistry, vegetation, soils, microbiological, and macrofaunal conditions at selected sites in the principal tropical environments of the Panama Canal Zone and the Rio Hato Military Reservation. The objective of the project is to assemble quantitative environmental data for RDT&E purposes.

Sites. Data summarized in this report were collected at the Albrook Forest and Chiva Chiva sites. Figure 1 shows the site locations within the Isthmus of Panama. Geographic coordinates are shown below:

Albrook Forest	09° 01'N, 79° 33'W
Chiva Chiva	09° 01'N, 79° 35'W

The Chiva Chiva open site and the Albrook Forest site are paired for comparative study of environmental conditions in a tropical semideciduous forest and in a large clearing. Both are located in a region where the annual precipitation is approximately 80 inches and there is a pronounced dry season. The other satellite sites were located primarily for soil studies purposes. Albrook and Fort Kcbbe have climatic regimes similar to the principal sites.

The Albrook and Chiva Chiva main sites are approximately four kilometers apart. Each has a 46 meter walk-up tower and an air-conditioned building to house the recording equipment and observers. Both sites are approximately 30 meters above sea level. The top of the forest canopy at the Albrook site is about 26.5 meters above the ground.

Instrumentation. A wide range of climatic elements are measured at the Albrook and Chiva Chiva sites. Types of observations and frequencies are shown on Figure 2. The towers at the Albrook and Chiva Chiva sites are similarly oriented. Sensing equipment is mounted at several levels on the towers to provide measurements through the vertical profile. Additional instruments are emplaced in the immediate vicinity on or near the ground. All instrument exposures are duplicated at each site. Figures 3, 4, and 5 show the instrument array at these sites.

Data Reduction and Storage. All data, as applicable, are recorded at or reduced to each full hour and transposed to punch cards. These punch cards, together with all raw data, are stored in the Tropic Test Center Technical Library Annex.

The relative humidity data contained in this report required some adjustment due to the difficult problems in maintaining hair hygrometers in the humid tropics. The hygrometers show saturation at a time when the psychrometer shows a relative humidity well below 100%. For this reason the hourly measurements made by means of a hair hygrometer have been modified on the basis of simultaneous psychrometer readings of other levels. Details will be given in the fourth Semianual Report. It can be assumed that the means of relative humidity presented in this volume are very close to the true means.

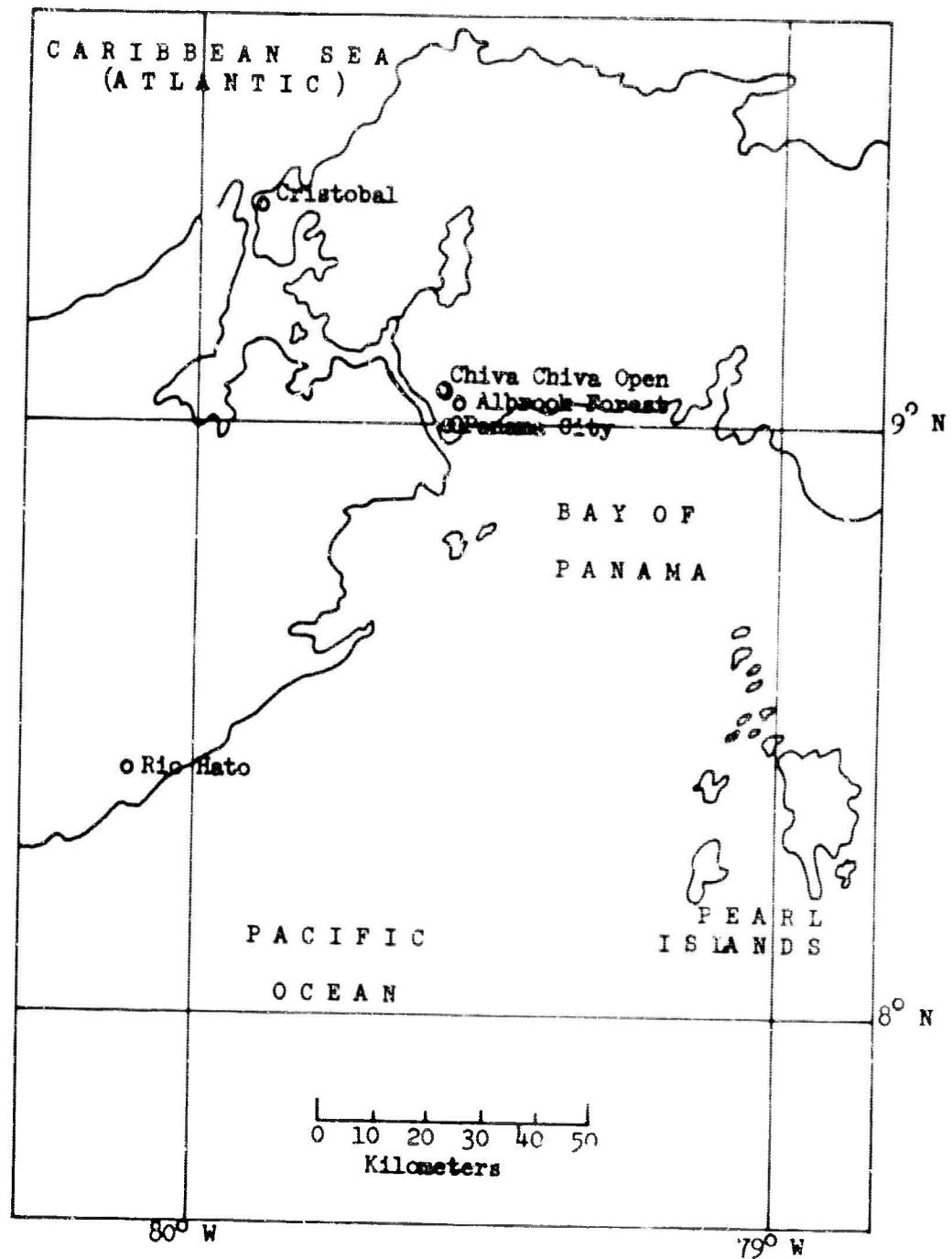


FIGURE 1. LOCATION MAP, Isthmus of Panama

FIGURE 2. FREQUENCY OF OBSERVATIONS

Height (meters)							
# Element	Sfc.	<u>0.5</u>	<u>1.0</u>	<u>2.0</u>	<u>4.0</u>	<u>8.0</u>	<u>13.5</u>
<u>Temperature:</u>							
Dry Bulb	-	1	1	1	-	1	-
Wet Bulb	-	1	-	1	-	-	-
Grass Minimum	3	-	-	-	-	-	-
<u>WBGT Index</u>	-	-	1	-	-	-	-
<u>Relative Humidity</u>	-	1	1	1	-	1	-
<u>Barometric Pressure</u>	-	-	1	-	-	-	-
<u>Evaporation</u>	-	1	-	-	-	2	-
<u>Precipitation:</u>							
Recording Gage	-	-	1	-	-	-	-
Manual Gage	-	-	2	-	-	-	-
Stem Flow	-	-	2	-	-	-	-
<u>Wind:</u>							
Direction	-	-	-	-	-	-	-
Speed	-	-	-	3**	1	-	-

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1. Albrook and Chiva Chiva	*
2. Albrook only	1 Hourly*/Continuous
3. Chiva Chiva only	1 Hourly
* Observations made with sling psychrometer when recorders are inoperative.	
** Hourly	
# Instrument descriptions are contained in the Environmental Data Base semiannual reports.	

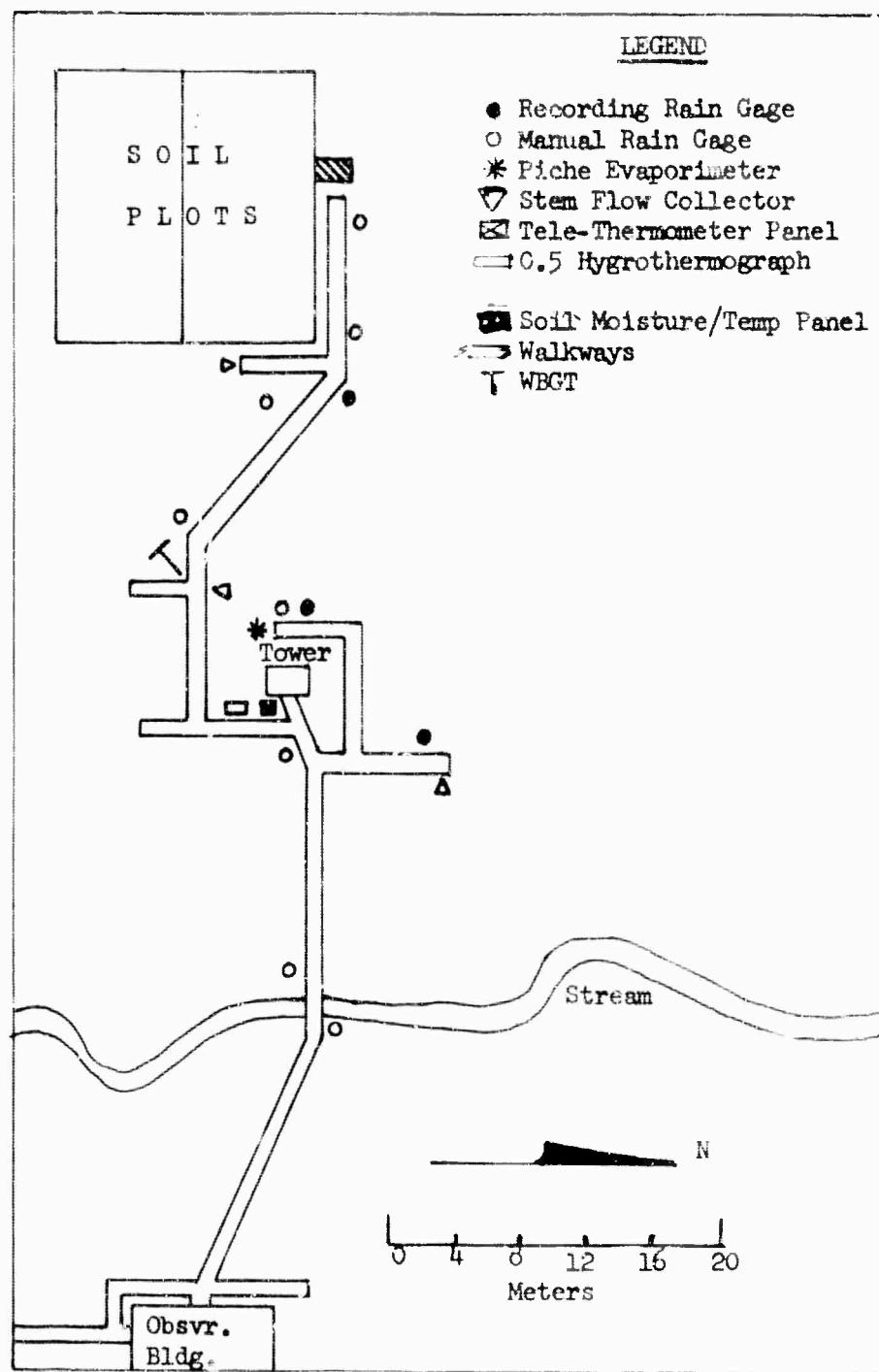


FIGURE 3. ALBROOK FOREST SITE, GENERALIZED PLOT

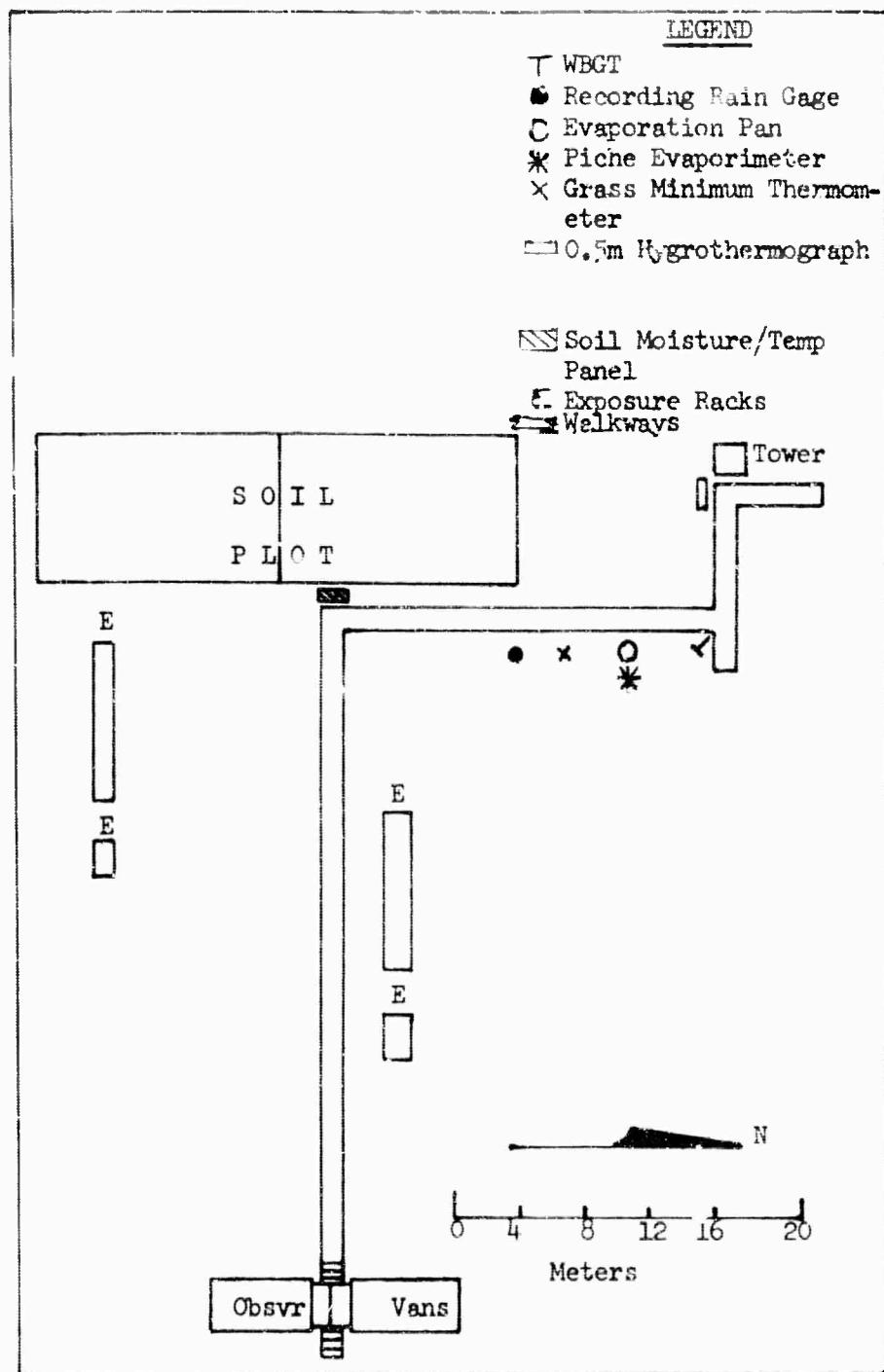


FIGURE 4. CHIVA CHIVA OPEN, GENERALIZED PLOT

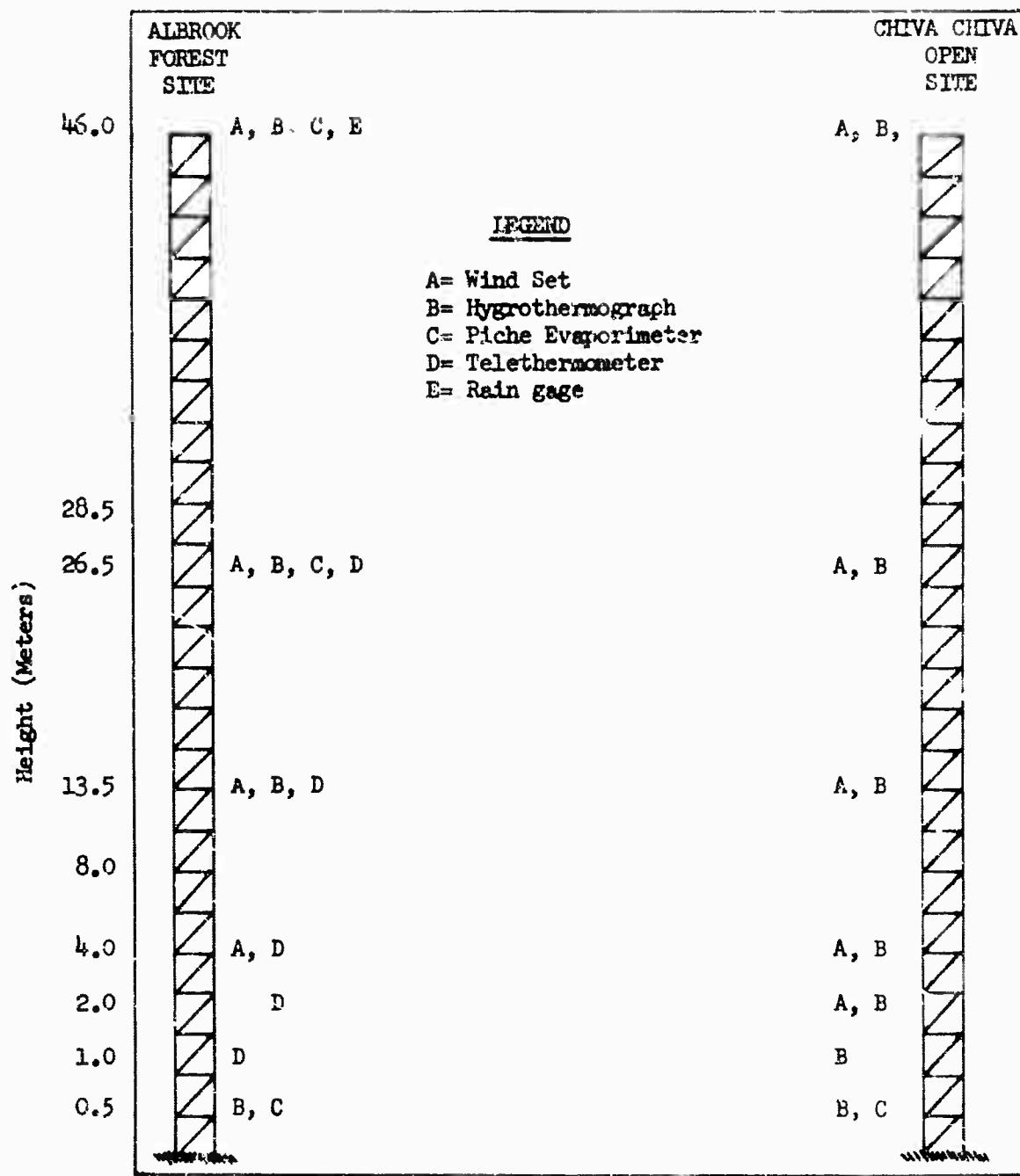


FIGURE 5. INSTRUMENT LOCATION ON TOWERS

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1967

Exposure		Monthly Ranges of A ^o Temperature by Hour (°F)																								Monthly Summary*	
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
ABERDEEN (Forest site)	46.0 m	3.2	3.5	4.1	4.1	3.4	4.6	5.5	7.4	11.2	12.6	10.5	11.5	12.2	14.3	14.7	12.3	10.9	10.1	6.4	5.5	5.3	4.4	4.1	4.5		
	28.5 m																										
	26.5 m																										
	13.5 m																										
	4.4 m																										
	0.0 m																										
This level was not instrumented for air temperature at this time																											
CHIYIA (Open site)	46.0 m	4.9	5.2	3.9	3.5	4.1	5.2	5.8	7.6	9.6	8.9	11.1	11.1	11.4	13.1	13.1	11.4	6.7	7.8	6.7	6.1	5.3	5.5	5.3	5.5		
	28.5 m																										
	26.5 m																										
	13.5 m																										
	4.0 m																										
	0.0 m																										
This level was not instrumented for air temperature at this time																											
CHIYIA (Open site)	46.0 m	1.8	3.6	4.7	3.7	4.3	5.6	7.7	12.3	16.6	13.3	11.9	11.4	14.0	14.1	13.6	11.1	10.3	8.9	7.5	6.5	5.1	4.9	4.9	4.7		
	28.5 m																										
	26.5 m																										
	13.5 m																										
	4.0 m																										
	0.0 m																										
This level was not instrumented for air temperature at this time																											
CHIYIA (Open site)	46.0 m	5.0	5.8	6.3	5.8	6.6	6.4	7.1	10.9	15.3	13.0	13.1	13.5	12.2	12.1	15.0	15.6	11.3	8.5	6.4	5.7	5.6	5.7	5.6	6.7		
	28.5 m																										
	26.5 m																										
	13.5 m																										
	4.0 m																										
	0.0 m																										
This level was not instrumented for air temperature at this time																											

* No monthly summary
was computed for
the ranges.

46.0 m	1.8	3.6	4.7	3.7	4.3	5.6	7.7	12.3	16.6	13.3	11.9	11.4	14.0	14.1	13.6	11.1	10.3	8.9	7.5	6.5	5.1	4.9	4.9	4.7			
28.5 m																											
26.5 m	4.0	3.7	4.4	4.5	4.6	6.0	9.3	12.7	17.6	11.9	11.4	11.0	13.3	14.4	13.6	11.7	10.7	8.8	7.0	6.7	5.6	5.1	4.9	4.8			
13.5 m																											
4.0 m																											
0.0 m																											
This level was not instrumented for air temperature at this time																											
46.0 m	5.0	5.8	6.3	5.8	6.6	6.4	7.1	10.9	15.3	13.0	13.1	13.5	12.5	12.1	15.0	15.6	11.3	8.5	6.4	5.7	5.6	5.7	5.6	6.7			
28.5 m																											
26.5 m																											
13.5 m																											
4.0 m																											
0.0 m																											
This level was not instrumented for air temperature at this time																											
46.0 m	6.2	5.5	5.5	5.5	5.5	6.8	10.5	16.1	13.5	13.5	14.2	13.0	13.6	16.4	14.1	12.9	8.5	5.7	6.4	5.3	5.3	5.2	5.2	6.3			
28.5 m																											
26.5 m	5.8	5.0	5.9	6.0	6.1	6.1	7.1	12.1	15.6	18.1	15.8	17.4	14.5	18.9	16.3	15.0	13.9	9.8	5.9	6.3	5.5	6.5	6.0	6.1			
13.5 m																											
4.0 m																											
0.0 m																											
This level was not instrumented for air temperature at this time																											

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1967

Monthly Means of Air Temperature by Hour
 (°F)

Exposure		Monthly Means of Air Temperature by Hour																								Monthly Summary				
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No. of Obs.	Min.	Mean	Max.	
46.0 m	75.3	75.2	75.1	75.6	74.8	74.5	74.8	76.0	76.1	80.3	81.9	83.1	83.3	82.5	81.4	79.1	78.3	77.5	76.5	76.1	75.9	75.8	75.7	75.6	740	71.2	77.6	88.5		
28.5 m																														
26.5 m	75.0	74.8	74.6	74.5	74.3	74.2	74.2	74.6	76.0	78.4	80.4	82.1	83.4	83.4	82.7	81.7	79.6	78.7	77.6	76.4	75.8	75.6	75.4	75.3	75.0	74*	71.0	77.5	88.8	
13.5 m	75.0	74.9	74.7	74.4	74.2	74.0	74.2	74.2	75.5	77.2	78.9	80.4	81.3	81.3	81.6	81.4	80.8	79.2	78.3	77.4	76.5	76.0	75.7	75.5	75.2	734	70.9	77.0	86.8	
8.0 m																														
4.0 m	74.6	74.4	74.3	74.1	73.9	73.7	74.3	76.1	77.6	79.0	80.1	81.1	81.1	80.2	78.6	77.7	76.9	75.9	75.6	75.3	75.2	75.1	74.9	74.9	744	70.5	76.7	86.8		
2.0 m	74.6	74.4	74.2	74.1	73.9	73.7	74.2	75.9	77.3	78.7	79.9	80.9	80.8	80.8	80.3	78.4	77.6	76.8	75.9	75.7	75.4	75.2	75.0	74.8	74.8	744	71.0	76.6	86.3	
1.0 m	74.7	74.5	74.3	74.2	73.9	73.7	74.3	75.6	77.2	78.5	79.6	80.6	80.8	80.7	80.1	78.4	77.6	76.8	76.0	75.7	75.4	75.3	75.2	75.0	744	70.8	76.6	85.8		
0.5 m	75.1	74.9	74.9	74.9	74.7	74.5	74.5	74.5	75.7	77.0	78.3	79.5	80.4	80.4	80.6	80.7	80.2	78.9	78.2	77.5	76.6	76.1	75.6	75.4	75.2	743	72.0	76.9	86.5	
0.0 m																														
46.0 m	75.3	75.4	75.0	75.0	74.9	74.7	74.6	74.6	75.7	78.1	80.3	81.8	82.7	83.7	83.4	82.0	80.5	79.2	78.1	77.3	76.5	76.3	76.1	75.9	75.8	75.5	739	71.6	77.9	88.8
28.5 m																														
26.5 m	75.0	74.9	74.8	74.8	74.6	74.6	74.4	75.6	78.2	80.1	81.6	82.3	83.5	83.3	82.3	81.0	79.5	78.3	77.6	76.7	76.5	76.2	76.0	75.8	75.6	744	71.0	77.9	89.6	
13.5 m	75.1	74.9	74.8	74.6	74.6	74.5	74.5	75.3	75.6	78.5	80.6	81.9	82.8	83.8	83.2	82.6	81.3	81.3	79.5	78.5	77.8	76.7	76.4	76.1	75.9	75.3	744	71.2	78.0	89.6
8.0 m																														
4.0 m	74.7	74.3	74.2	74.0	73.9	73.8	74.0	74.6	75.0	77.7	79.7	81.2	81.7	81.7	81.2	80.4	79.2	78.2	77.0	76.7	76.4	76.0	75.4	75.1	75.1	738	70.2	78.0	89.8	
2.0 m	74.6	74.2	74.1	74.0	73.8	73.6	74.0	74.9	77.6	79.9	82.1	83.5	85.0	85.2	84.3	82.6	80.6	79.3	78.2	76.9	76.5	76.3	75.8	75.2	74.9	738	70.9	78.0	91.1	
1.0 m	74.5	74.2	74.1	73.7	73.6	73.3	73.5	75.1	78.0	80.5	82.8	84.1	85.7	85.0	83.9	82.5	80.4	79.1	77.9	76.4	76.0	75.8	75.3	75.1	74.9	741	70.2	78.0	93.2	
0.5 m	74.4	74.0	74.0	73.6	73.6	73.3	73.6	73.6	75.0	78.1	80.7	83.2	84.7	86.4	85.6	84.2	82.6	80.5	79.2	77.9	76.5	76.1	75.8	75.2	75.1	741	70.3	78.1	92.9	
0.0 m																														

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1967

Exposure		Monthly Means of Relative Humidity by Hour (%)																								Monthly Summary						
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	% of Max.	% of Min.					
	46.0 m	95	95	95	95	95	95	95	95	93	87	82	78	76	76	77	81	85	87	87	91	93	94	95	95	740	64	69	97			
	28.5 m	95	95	95	95	95	95	95	96	96	87	82	78	76	75	77	80	84	86	88	90	94	94	95	95	95	734	63	89	98		
	26.5 m	95	95	95	95	95	95	95	95	95	96	96	92	87	85	81	81	81	83	87	88	91	93	94	95	95	733	61	91	99		
	13.5 m	96	96	96	96	96	96	96	96	97	97	96	92	87	85	81	81	81	83	87	88	91	93	94	95	95	732	60	90	98		
	8.0 m																															
	4.0 m	97	97	97	98	98	98	98	98	98	98	98	95	92	90	88	85	87	86	87	90	92	93	94	95	96	97	97	97	97	94	100
	2.0 m	97	97	98	98	98	98	98	98	98	98	98	96	93	91	89	87	89	87	83	91	93	93	95	96	96	97	97	97	94	100	
	1.0 m	97	97	98	98	98	98	98	98	98	98	98	94	92	91	89	89	89	89	90	92	94	94	95	96	96	97	97	97	95	100	
	0.5 m	97	97	97	97	97	98	98	97	96	95	93	91	90	91	90	91	90	91	93	93	94	95	96	96	96	97	97	95	100		

Exposure		Monthly Means of Relative Humidity by Hour (%)																								Monthly Summary						
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	% of Max.	% of Min.					
	46.0 m	94	95	95	95	95	95	95	95	93	88	83	79	79	77	75	75	77	82	85	87	88	91	91	92	92	93	737	63	88	98	
	28.5 m	94	95	95	95	95	95	95	96	95	93	87	83	79	77	74	74	76	81	85	86	88	91	92	93	93	94	737	58	86	98	
	26.5 m	94	95	95	95	95	95	95	96	96	93	86	81	78	77	75	75	76	81	85	86	88	91	92	93	93	94	736	58	86	98	
	13.5 m	95	96	95	95	96	96	96	96	96	96	93	86	81	78	78	77	75	75	76	81	85	86	88	91	92	93	94	735	58	86	98
	8.0 m																															
	4.0 m	96	96	96	97	97	97	97	97	97	95	89	84	79	76	73	72	75	79	83	86	87	90	92	93	94	95	733	57	88	100	
	2.0 m	96	96	96	97	97	97	97	97	97	96	90	85	80	77	73	73	75	79	83	86	88	91	92	93	94	95	732	55	89	100	
	1.0 m	96	97	97	97	97	97	97	97	97	96	89	83	80	77	74	75	77	81	85	88	89	92	93	94	95	96	729	63	89	100	
	0.5 m	96	97	96	97	97	97	97	97	97	97	91	81	79	74	76	74	74	76	81	85	84	87	89	92	93	94	95	741	60	89	100

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
JULY 1967

Exposure		Monthly Ranges of Relative Humidity by Hour (%)																								Monthly Summary*	
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
46.0 m	4	6	5	4	4	4	3	12	20	25	26	29	30	31	30	29	26	25	19	11	10	10	9	4			
28. m	9	10	8	6	5	6	6	10	12	20	25	30	33	35	37	34	31	31	28	22	16	13	12	11			
26.5 m	12	10	11	11	10	10	15	16	25	21	22	21	32	33	32	28	22	16	12	12	11	10	9	4			
13.5 m	9	10	8	6	5	6	6	10	12	20	25	30	33	35	37	34	31	31	28	22	16	13	12	11			
8.0 m	4.0 m	10	11	9	5	6	4	6	11	18	21	25	28	31	32	28	30	27	24	20	12	17	10	10	8		
Abrook (Forest site)	2.0 m	10	12	6	5	6	6	5	10	15	14	25	26	27	24	25	24	27	22	16	12	10	9	11	7		
1.0 m	8	8	6	6	5	4	4	7	11	13	20	25	31	24	20	21	25	29	14	12	10	10	11	9			
0.5 m	6	8	8	7	6	7	4	10	12	19	21	19	23	20	15	19	16	13	9	7	8	8	7				

* No monthly summary
was computed for
the ranges.

Exposure		Monthly Ranges of Relative Humidity by Hour (%)																								Monthly Summary*	
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
46.0 m	9	9	9	8	8	9	9	22	26	23	27	25	27	28	33	29	23	22	16	12	7	10	10	9			
28.5 m	8	9	8	7	9	7	10	22	22	32	24	26	29	30	32	37	32	27	23	15	10	8	9	8	8		
26.5 m	9	10	9	9	8	13	23	28	21	23	23	24	24	24	33	29	24	23	17	11	8	10	10	10			
13.5 m	9	10	9	9	8	13	23	28	21	23	23	24	24	24	33	29	24	23	17	11	8	10	10	10			
8.0 m	4.0 m	12	10	10	10	8	11	19	28	24	31	30	33	34	34	35	34	38	35	29	23	20	13	12	11	9	14
Abrook (Open site)	2.0 m	10	10	10	8	8	8	11	17	30	24	31	31	30	33	34	34	35	34	38	35	29	23	20	13	12	11
1.0 m	9	8	10	10	10	8	7	10	11	11	23	32	25	28	28	26	28	28	27	23	13	12	11	9	11	9	
0.5 m	10	9	8	12	13	13	16	19	27	30	35	36	34	38	38	38	36	29	27	14	3	11	12	20	20	20	

* No monthly summary
was computed for
the ranges.

* * * SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
JULY 1967

Exposure	Site	Monthly Means ² of other Elements by Hour																								Monthly Summary						
		Code ¹	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	88.8 ³	Min.	Max.			
WB	(4.0 m)	W3	73.9	73.8	73.7	73.5	73.3	73.9	75.0	75.7	76.6	77.2	77.5	77.8	77.5	77.2	76.2	75.8	75.2	74.7	74.5	74.5	74.4	74.2	74.4	70.4	75.2	81.2				
WB	(2.0 m)	WB	74.0	73.8	73.8	73.7	73.5	73.3	73.8	75.1	75.7	76.7	77.3	77.8	78.0	77.7	77.4	76.4	76.0	75.3	74.8	74.7	74.6	74.5	74.2	74.4	70.9	75.3	81.0			
WB	(0.5 m)	WB	74.5	74.3	74.2	74.1	73.9	73.8	73.9	75.0	75.9	76.7	77.5	78.0	78.5	78.3	78.0	77.1	76.6	76.1	75.5	75.2	75.1	74.9	74.8	74.7	74.2	70.8	75.7	81.4		
BP	Albrook (Forest site)	BP	-753	-738	-727	-722	-724	-729	-746	-733	-766	-773	-772	-762	-742	-724	-706	-698	-696	-702	-717	-736	-756	-766	-775	-767	744	640	-740	-875		
P1		P1	0.00	0.04	0.01	0.01	0.05	0.20	0.15	0.12	0.10	0.01	0.06	0.02	0.02	0.02	0.23	0.11	0.35	0.11	0.08	0.05	0.03	0.03	0.01	0.01	0.09	0.39	69	0.01	7.91	0.90
P2		P2	0.00	0.01	0.02	0.02	0.00	0.03	0.03	0.32	0.32	0.26	0.07	0.06	0.04	0.05	0.01	0.04	0.38	0.06	0.40	0.08	0.02	0.00	0.01	0.00	0.00	0.22	37	0.01	4.76	0.69
P3		P3	0.00	0.05	0.00	0.00	0.00	0.03	0.20	0.25	0.20	0.11	0.03	0.09	0.00	0.00	0.00	0.77	0.05	0.48	0.34	0.06	0.00	0.00	0.00	0.00	0.50	25	0.01	4.99	0.77	
P4		P4	0.00	0.02	0.00	0.00	0.03	0.21	0.27	0.22	0.27	0.07	0.04	0.02	0.00	0.00	1.20	0.14	0.47	0.21	0.03	0.01	0.00	0.02	0.00	0.01	0.25	41	0.01	7.97	1.20	

WB	(4.0 m)	WB	73.8	73.6	73.4	73.4	73.1	73.9	75.2	75.8	76.5	77.0	77.3	77.4	77.2	76.8	76.3	75.8	75.4	74.9	74.8	74.5	74.2	74.1	7.8	70.2	75.1	80.3		
WB	(2.0 m)	WB	73.7	73.5	73.4	73.3	73.2	73.1	74.0	75.4	76.2	77.0	77.6	78.0	78.1	77.8	77.2	76.5	75.9	75.4	74.9	74.8	74.7	74.5	74.1	74.0	73.8	70.3	75.2	81.5
WB	(0.5 m)	WB	73.6	73.3	73.2	73.1	73.1	73.0	74.3	76.1	77.2	78.2	79.0	79.4	78.7	77.4	76.5	75.9	75.3	74.7	74.6	74.4	74.2	73.8	73.7	74.1	68.3	75.5	83.1	
BP	Chitva (Open site)	BP	-849	-844	-823	-818	-818	-824	-838	-851	-864	-870	-861	-840	-824	-807	-797	-795	-800	-814	-834	-852	-862	-870	-865	744	.740	.837	.950	
PS		PS	0.09	0.00	0.00	0.03	0.09	0.44	0.23	0.25	0.07	0.02	0.07	0.05	0.26	0.79	0.06	0.35	0.06	0.02	0.00	0.00	0.05	0.11	57	0.01	10.55	1.66		

¹ WB = Wet bulb temperature ($^{\circ}$ F)
BP = Barometric pressure (in. of Hg minus 29.0)

PS = Precipitation at 1.0 m. in open area (in.)
P1 = Precipitation at 46.0 m. above canopy (in.)

P2 = Precipitation under full canopy (in.)
P3 = Precipitation under drip canopy (in.)

P4 = Precipitation under open canopy (in.)
2 Monthly means of precipitation are computed for precipitation days.
Precipitation totals are substituted for the mean in the monthly summary.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1957

Exposure	Site Code	Monthly Ranges ² of other Elements by Hour																							
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
(Forest Site)	WB (4.0 m)	4.3	4.2	3.3	3.5	3.9	4.9	5.6	6.2	7.0	6.5	6.3	6.0	7.2	7.7	6.5	5.8	4.5	4.3	4.8	4.3	4.2	4.5	4.6	4.7
	WB (2.0 m)	4.2	4.1	3.7	3.4	3.8	5.0	5.1	6.0	7.3	6.3	6.2	6.0	6.6	7.7	7.7	5.7	5.1	5.5	4.4	4.1	4.1	4.4	4.1	4.5
	W3 (0.5 m)	3.7	3.6	3.4	3.7	3.8	4.1	4.8	6.0	7.2	6.4	5.8	5.8	4.9	7.2	6.9	6.7	5.6	5.9	4.4	4.4	4.1	4.0	4.1	3.6
	BP	1.20	1.25	1.35	1.40	1.20	1.45	1.60	1.70	1.40	1.30	1.35	1.40	1.40	1.35	1.20	1.25	1.10	1.15	1.20	1.25	1.15	1.15	1.30	
	P1	0.00	0.05	0.00	0.00	0.05	0.51	0.35	0.12	0.22	0.01	0.02	0.00	0.02	0.06	0.19	0.86	26	0.19	0.13	0.03	0.00	0.00	0.00	0.00
	P2	0.00	0.00	0.00	0.00	0.02	0.54	0.19	0.13	0.09	0.00	0.00	0.00	0.01	0.68	0.13	0.02	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Abrook (Forest Site)	P3	0.00	0.01	0.00	0.00	0.00	0.45	0.39	0.08	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.47	0.10	0.00	0.00	0.00	0.00	0.00
	P4	0.00	0.01	0.00	0.00	0.00	0.67	0.63	0.24	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.09	0.00	0.00	0.00	0.00	0.00	0.48

* No monthly summary
 was computed for
 the ranges

Exposure	Site Code	Monthly Summary*																							
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
(Forest Site)	WB (4.0 m)	5.3	5.1	4.6	5.1	4.9	5.2	5.8	7.5	8.7	7.3	6.1	5.8	6.1	5.2	6.4	7.1	6.2	5.3	4.6	4.4	4.2	3.6	4.3	4.9
	WB (2.0 m)	5.0	4.8	4.4	4.4	4.6	5.2	5.7	7.7	9.1	7.6	6.6	6.0	7.3	5.4	6.9	7.1	6.6	5.1	4.6	3.9	3.9	3.8	4.1	4.8
	W3 (0.5 m)	5.2	4.7	4.7	5.6	6.0	9.5	7.5	8.4	9.0	8.9	8.2	7.7	7.5	9.6	7.5	7.2	7.8	4.7	4.5	4.9	3.7	5.0	7.5	8.5
	BP	1.25	1.25	1.35	1.30	1.25	1.55	1.55	1.30	1.35	1.35	1.35	1.35	1.30	1.30	1.30	1.30	1.20	1.25	1.20	1.20	1.15	1.15	1.15	1.15
	PS	0.00	0.00	0.00	0.04	0.20	0.23	0.46	0.45	0.11	0.01	0.11	0.07	0.74	1.65	0.12	1.42	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	CHIWA (Open Site)	5.3	5.1	4.6	5.1	4.9	5.2	5.8	7.5	8.7	7.3	6.1	5.8	6.1	5.2	6.4	7.1	6.2	5.3	4.6	4.4	4.2	3.6	4.3	4.9

WB = Wet bulb temperature (°F)
 BP = Barometric pressure (in. of mercury 29.92)
 PS = Precipitation at 1.0 m. in open area (in.)
 P1 = Precipitation at 46.0 m. above canopy (in.)
 P2 = Precipitation under full canopy (in.)
 P3 = Precipitation under drip canopy (in.)
 P4 = Precipitation under open canopy (in.)

2 Monthly ranges of precipitation are computed for precipitation days.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1967

Exposure	Site	Level	Monthly Means of Wind Speed by Hour (miles/hr.)																								Monthly Summary			
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Abrook (Forest Site)	46.0 m	5	6	6	6	6	6	6	6	6	6	5	6	7	7	9	8	8	8	7	7	6	6	6	5	6.31	0	6	17	
	28.5 m																													
	26.5 m	3	2	2	2	2	2	2	2	2	2	1	2	3	3	4	4	4	4	3	3	2	2	3	3	2	4.49	0	3	12
	13.5 m																													
	8.0 m																													
	4.0 m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.669	0	0	6	
	2.0 m																													
	1.0 m																													
	0.5 m																													

Exposure	Site	Level	Monthly Means of Wind Speed by Hour (miles/hr.)																								Monthly Summary					
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24						
Chiva Chiva (Open Site)	46.0 m	5	4	5	4	4	5	4	5	6	5	6	5	7	7	8	8	8	8	7	6	5	6	5	6	5	3.71	0	6	18		
	28.5 m																															
	26.5 m	4	3	3	3	3	4	3	4	5	5	4	7	6	8	8	8	7	7	5	5	4	4	5	4	4	5.75	0	5	21		
	13.5 m	2	1	2	1	1	1	1	1	1	1	1	1	3	3	4	4	4	5	5	6	6	6	5	4	4	3	2	7.33	0	3	18
	8.0 m																															
	4.0 m	3	2	2	2	2	3	2	3	2	3	2	3	2	3	3	4	4	5	5	6	6	6	5	4	4	3	3	6.73	0	4	14
	2.0 m	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3	3	2	2	1	1	1	1	1	7.34	0	2	12
	1.0 m																															
	0.5 m																															

Note: Data at 46.0 meters represent the first 21 days of the month only.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

JULY 1967

Exposure		Monthly Ranges of Wind Speed by Hour (miles/hr.)																								Monthly Summary*		
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
46.0 m	9	12	11	5	10	11	11	10	11	13	16	11	12	10	16	10	13	12	13	10	11	10	11					
28.5 m	6	4	6	4	5	5	5	6	7	9	12	9	7	9	7	8	8	7	7	5	5	8	7	5				
26.5 m	6	4	6	4	5	5	5	6	7	9	12	9	7	9	7	8	8	7	7	5	5	8	7	5				
13.5 m	8.0 m	0	1	3	2	1	6	1	1	2	2	1	2	2	2	2	1	1	1	1	1	1	1	0				
Albrook Forest Site	4.0 m	0	1	3	2	1	6	1	1	2	2	1	2	2	2	2	1	1	1	1	1	1	1	0				
Albrook Forest Site	2.0 m																											
Albrook Forest Site	1.0 m																											
Albrook Forest Site	0.5 m																											

* No monthly summary
was computed for
the ranges.

Exposure		Monthly Ranges of Wind Speed by Hour (miles/hr.)																								Monthly Summary*		
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
46.0 m	12	8	8	7	7	12	11	10	8	10	11	14	14	14	11	13	9	10	11	8	11	7	8	12	10			
28.5 m	13	14	13	6	8	16	6	6	7	7	11	13	19	16	14	11	9	12	9	9	7	8	9	7				
26.5 m	10	10	10	5	5	6	4	5	8	7	12	13	18	11	12	10	10	10	6	9	8	7	9	8				
13.5 m	8.0 m	7	7	5	5	14	6	5	7	8	11	11	11	9	10	9	11	9	6	7	6	6	7	6				
Albrook Forest Site	4.0 m	5	5	4	3	3	4	1	3	5	5	7	8	10	7	12	8	8	7	5	5	4	4	5	3			
Albrook Forest Site	2.0 m																											
Albrook Forest Site	1.0 m																											
Albrook Forest Site	0.5 m																											

Note: Data at 46.0 m meters represent the first 21 days of the month only.

ALBROOK (Forest site) JULY 1967

Relative Frequencies* of Wind Directions by Hour at 46.0 m.

Dir.	(%)																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.2	3.3	3.3	3.3	10.0			6.4	10.0	13.7	13.7	10.3	3.4	10.7	6.8	10.3	3.5	
NNE												3.4			3.3	3.3	3.2	10.0	6.8						3.5
NE												3.4			3.3	3.3	3.2	10.3	3.4						3.5
ENE												3.4			3.3	3.3	3.2	10.3	3.4						3.5
E	3.4											3.4			3.3	3.3	3.3	6.8							3.4
ESE												3.4			3.3	3.3	3.3	6.8							3.4
SE												3.4			3.3	3.3	3.3	6.8							3.5
SSE												3.4			3.3	3.3	3.3	6.6							3.5
S												3.4			3.3	3.3	3.3	6.6							3.5
SSW												3.4			3.3	3.3	3.3	6.6							3.5
SW	3.4	3.4										3.4			3.3	3.3	3.3	6.6							3.5
WSW												3.4			3.3	3.3	3.3	6.6							3.5
W												10.3	3.4	17.1	10.0	6.6	20.0	13.3	10.0	3.4	10.3				3.5
WNW	17.1	3.4	6.8	10.3	10.3	17.1	3.4	20.0	20.0	13.3	6.6	20.0	26.6	6.6	12.9	26.6	20.6	13.7	13.7	6.8	17.7	13.7	6.8	14.2	
NW	27.3	41.0	20.6	20.6	20.6	24.0	24.0	20.0	13.3	29.9	20.0	10.0	6.6	10.0	22.6	13.3	10.3	3.4	17.1	30.7	21.3	17.1	30.7	31.9	
NNW	13.7	27.3	34.1	41.0	34.1	34.1	27.3	23.3	13.3	23.3	23.3	6.6	20.0	20.0	29.0	20.6	41.0	34.1	17.7	37.6	34.1	21.3			
CALM	6.8	6.8	3.4	10.3	10.3	16.6	10.0	10.0	3.3																

* Note: Due to rounding, percentage totals do not equal 100%.

* IMPERSONAL ■ AERIAL

ALBROOK (Forest site) JULY 1967

Relative Frequencies* of Wind Directions by Hour at 26.5 m.

Dir.	(%)																										
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
N	15.4	11.5	7.6	7.6	7.6	3.8	7.3	7.0	14.2	6.8	3.5	10.7	7.0	3.5	6.0	10.3	7.0	7.0	14.2	10.7	11.0	3.8	16.0				
NNE	3.8					3.8				3.5	3.4	7.0		3.5		3.3	10.3	7.0	3.5	3.5	1.1	2	3.6				
NE	3.8									3.4	3.5	3.5				6.6	3.4	10.7	3.5			3.5		4.0			
ENE																		6.8	3.5								
E						3.8	3.6	3.5																			
ESE																3.5		3.3									
SE																3.5	3.5	3.3									
SSE																3.5	10.7	3.3									
S																3.5	10.7	6.6	3.4								
SSW																											
SW	3.8					3.8				3.5	3.5	7.0	14.2	14.2	3.5												
WSW												7.0	3.4	3.5	7.0	3.5	10.7	3.4									
W	3.8	3.8														3.5	3.5										
WNW	7.6	15.4	7.6	7.6	11.5	7.6	7.3	21.3	10.7	13.7	10.7	10.7	7.0	14.2	16.6	17.1	7.0	3.5	7.0	3.5	11.0	7.0	11.5				
NW	30.7	26.9	38.3	7.6	30.7	26.9	18.4	24.9	28.4	24.0	10.7	14.2	7.0	14.2	26.6	30.7	24.9	39.0	31.9	24.9	11.0	31.9	26.9	32.0			
NNW	23.1	30.7	46.0	19.1	26.9	22.1	14.2	17.7	10.3	24.9	10.7	17.0	14.2	10.0		7.0	21.3	17.7	17.7	7	4	24.9	34.5	28.0			
CALM	11.5	7.6	15.4	19.1	23.1	19.1	33.1	21.3	14.2	20.6	10.7	10.7	7.0	10.7	10.0	13.7	14.2	17.7	17.7	21.3	14.7	24.9	19.1	12.0			

* Note: Due to rounding, percentages totals do not equal 100%.

IMPERSONAL: ■ PERSONAL

ALBROOK (Forest site) JULY 1967

Relative Frequencies* of Wind Directions by Hour at 4.0 m.

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N																								
NNE																								
NE																								
ENE																								
E																								
ESE																								
SE																								
SSE																								
S																								
SSW																								
SW																								
WSW																								
W																								
WNW																								
NW																								
NNW																								
CALM	95.0	91.9	84.5	92.1	92.1	88.3	92.0	84.5	65.2	72.9	72.9	72.9	72.9	62.5	59.1	68.0	72.0	76.0	84.0	92.0	92.0	92.0	95.7	

• Note: D.

*Fig. percentage totals do not equal 100%.

INTERPOLATION

A D

CHIVA CHIVA (Open site) JULY 1967

Relative Frequencies* of Wind Directions by Hour at 46.0 m.

Dir.	Relative Frequencies* of Wind Directions by Hour at 46.0 m. (%)																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N	11.7	5.9							4.8						5.0	5.0	5.0						15.0	16.7	16.7
NNE																5.0									
NE																									
ENE																									
E																									
ESE																									
SE																									
SSE																									
S																									
SSW																									
SW																									
WSW																									
W	17.6	5.9	6.3	5.9	23.8	4.8	23.8			9.5	10.0	5.0	10.0												
WNW	29.3	11.7	41.0	18.7	29.3	23.8	47.0	33.3	23.8	19.0	15.0	25.0	35.0	30.0	20.0	20.0	20.0	15.0	30.0	25.0	15.0		11.1		
NW	23.4	52.8	58.5	35.2	43.6	46.0	23.8	28.6	19.0	52.4	38.1	40.5	20.0	15.0	35.0	55.0	40.0	45.0	65.0	60.0	55.0	50.0	50.8	38.9	
NNW	5.9	17	11.7	6.3	11.7	19.0	9.5	4.8	4.3	5.5	15.0	20.0	10.0	10.0	25.0	25.0	10.0	5.0	20.0	10.0	22.2	11.1			
CAIM	11.7	11.7	11.7	5.9	12.4	9.5	4.2																5.6	11.1	

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA

Open site

JULY 1967

CHIVA CHIVA (Open site); JULY 1967

Relative Frequencies* of Wind Directions by Hour at 26.5 m.
(%)

Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N	12.9	12.9	16.1	6.6	16.6	3.3	6.4	9.7	3.2	6.4	9.7	6.4	22.6	3.2	6.4	3.2	16.1	12.9	9.7	16.1	9.7	3.3	10.3		
NNE	3.2	3.2	6.4	3.3	3.3	3.2																			
NE	3.2	3.2	3.3																						
ENE																									
E																									
ESE																									
SE																									
SSE																									
S																									
SSW																									
SW																									
WSW																									
W	12.9	3.2	3.2	6.4	3.3	6.4	3.2	3.2	6.4	6.4	6.4	6.4	6.4	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	
WNW	9.7	12.9	20.0	16.6	3.3	13.3	9.7	16.1	6.4	3.2	9.7	12.9	12.9	9.7	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	
NW	16.1	22.6	25.8	23.3	39.9	20.6	12.4	19.4	29.1	38.7	22.6	19.4	22.6	25.8	32.2	38.7	32.2	22.6	41.9	41.9	32.2	35.5	20.0	24.0	
NNW	19.4	16.1	22.6	23.3	13.3	20.0	19.4	12.9	22.6	16.1	29.0	12.9	12.9	19.4	29.0	32.2	25.0	29.0	22.6	22.6	53.1	20.6			
CAIM	16.1	16.1	19.4	10.0	10.0	6.6	12.9																		

• Note: Due to rounding, percentage totals do not equal 100%.

* PERIODIC & AVERAGE

CHIVA CHIVA (Open site) JULY 1967

Relative Frequencies* of Wind Directions by Hour at 4.0 m.

Dir.	{ % }																										
	Hr. 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
N	24.0	10.3	17.1	6.8	14.2	13.7	6.4	6.4	16.1	16.1	19.4	6.4	9.7	6.4	11.1	16.1	16.1	6.4	29.0	12.9	13.3	16.6					
NNE		6.8	3.4	3.4	7.0	3.4		3.4		3.2	3.2	6.4	3.2	3.2	6.4							3.2	6.4				
NE	10.3	13.7	6.8	10.3		3.4	6.4	3.2	6.4			3.2		3.2								3.2	6.6				
ENE	3.4					6.8	3.2	3.2		5.2	3.2											3.2	6.6				
E	3.4		6.8	3.4	3.5	6.8	3.2	3.2						6.4								3.2	3.2	3.3			
ESE						3.4	6.4			3.2	3.2		6.4									6.4	3.3				
SE												3.2		3.2	6.4	6.4	3.2						3.2				
SSE													3.2		3.2								3.2				
S														3.2	3.2	5.4	3.2							3.3	3.3		
SSW														3.2	3.2	3.2								3.2			
SW															3.2	3.2									3.2		
WSW																3.2	3.2										
W																	3.2										
WNW																		3.2									
NW																			3.2								
NNW																				3.2							
CALM																											

* Note: Due to rounding, percentage totals do not equal 100%.

* * * * *

SUMMARY OF NON HOURLY DATA

JULY 1967

Summary of Elements with Non-hourly Frequencies of Observations						
Site	Element, Units and Exposure	Description	Number of Obs.	Minimum Value	Mean or Total Value	Maximum Value
	WBGT Index ¹ (at 1.0 meters)	Index value Dry bulb temp. Wet bulb temp. Black bulb temp.	434 434 434 434	70.5 70.5 70.3 71.0	77.0 77.9 76.5 78.5	82.8 86.0 82.0 88.0
	Evaporation ³ (at 4 levels)	Piche (46.0 m) Piche (26.5 m) Piche (13.5 m) Piche (0.5 m)	29 28 27 26	0.043 0.043 0.006 0.006	5.921* 5.392* 1.641* 0.814*	0.470 0.518 0.140 0.085
Altbrook (Forest site)	Precipitation from Raingauge Network ² (in. at 1.0 meters)	Gauge # 1 Gauge # 2 Gauge # 3 Gauge # 4 Gauge # 5 Gauge # 6 Gauge # 7 Gauge # 8	27 28 28 27 28 28 28 28	0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01	5.18* 8.44* 8.41* 8.39* 7.24* 7.34* 8.01* 7.17*	1.04 1.10 1.23 1.26 1.20 1.05 1.25 1.15
	Stem Flow ² (in. at 2.0 meters)	Small tree Medium tree Large tree	26 23 20	0.01 0.01 0.01	8.81* 9.32* 39.75*	2.00 2.00 11.49
	WBGT Index ¹ (at 1.0 meters)	Index value Dry bulb temp. Wet bulb temp. Black bulb temp.	432 432 432 432	69.8 70.0 69.8 70.0	79.7 80.5 77.0 88.6	89.6 94.8 83.3 118.1
	Evaporation ³ (in. a ^{0.5} meters)	Piche Pan	31 27	0.006 0.021	4.025* 3.653*	0.482 0.287
Chuva Chiva (Open site)	Minimum Grass temp. ³ (°F at grass tips)	None	29	67.5	70.7	74.0

* Total Values

1 - Hourly observations between 0600 and 1900 hours inclusive

2 - Six hourly observations

3 - Daily observations

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13. ABSTRACT This report contains detailed microclimatic data for July 1967 from specific sites in the Panama Canal Zone and vicinity. The data are presented in tabular form, summarized for hourly and/or daily observations from surface to 46-meter levels. Elements listed are: temperature, pressure, precipitation, wind speed and direction, relative humidity, and evaporation.		

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